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RICHARD W. WICKING
CLERK, U.S. DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA

DR.LAKSHMI ARUNACHALAM
222 Stanford Avenue, Menlo Park, CA 94025
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Pro Se Plaintiff

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

HRL

CV 15 0024

DR. LAKSHMI ARUNACHALAM,

Plaintiff,

vs.

TRULIA, INC.,

Defendant

Case No.:

COMPLAINT FOR PATENT
INFRINGEMENT

DEMAND FOR JURY TRIAL
YES

I. Parties in this Complaint:

a. Plaintiff.

DR. LAKSHMI ARUNACHALAM
222 Stanford Avenue, Menlo Park, CA 94025
TEL: (650) 690-0995 EMAIL: laks22002@yahoo.com

b. Defendant.

Defendant 1:

TRULIA, INC.,

116 New Montgomery Street, Suite 300

San Francisco, CA 94105

Tel: 415.648.4358

Plaintiff, DR. LAKSHMI ARUNACHALAM, alleges:

1. Plaintiff DR. LAKSHMI ARUNACHALAM, (hereinafter “Dr. Arunachalam”) is, and at all times herein mentioned was an individual residing at 222 Stanford Avenue, Menlo Park, CA 94025. Dr. Arunachalam is the inventor and assignee of the patent-in-suit.
2. On information and belief, Defendant, TRULIA, INC. (herein after “TRULIA”) is headquartered at 116, New Montgomery Street, Suite 300, San Francisco CA 94105.

II. JURISDICTION AND VENUE

3. This is an action for patent infringement arising under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).
4. Plaintiff Dr. Lakshmi Arunachalam is, and at all times herein mentioned a California resident and an individual residing at 222 Stanford Avenue, Menlo Park, CA 94025 and the sole inventor and owner of a portfolio of early Internet patents (11 patents and 2 pending patent applications). These patents relate to real-time Web transactions from Web applications. Dr. Arunachalam’s patents and patented technology are horizontal patents that have been in use by large enterprises and mid-sized and small businesses, for example, Web banking

1 applications, online travel, online business applications on the Web, mobile applications, and
2 Web applications in all vertical markets. At all times relevant to this action, Dr.
3 Arunachalam has resided in California when she invented the inventions in her patents, when
4 she did experimentation to create prototypes of the patented technology, and installed it at
5 beta sites in California. She founded several start-ups and is an Internet pioneer in Silicon
6 Valley, California. She has been at the forefront of innovation in Silicon Valley. She
7 provided software solutions to complex business problems that needed a technological
8 solution and invented and developed Web applications such as Web banking and other
9 business Web applications, even prior to 1995, when one-way Web browsing was the norm
10 and sophisticated solutions like Web banking did not exist. At all times relevant to this
11 action, Dr. Arunachalam has resided in California and ran her companies and when she
12 invented and wrote her 13 patents and patent applications, raised venture capital, hired
13 employees, when she did experimentation to create prototypes of the patented technology,
14 and installed it at beta sites in California. Dr. Arunachalam continues to work in California
15 in patent litigation related to the assertion of her many patents, with many infringers and
16 defendants in California. At all times relevant to this action, Dr. Arunachalam has been
17 working in California in San Mateo County. So, a substantial part of the property that Dr.
18 Arunachalam is suing about is located in California. All her intellectual property is in
19 California. A substantial part of the events Dr. Arunachalam is suing about happened in this
20 district in California. Hence, this district is the proper location to file this lawsuit.

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25 5. This Court has personal jurisdiction over the Defendants by virtue of their being
26 headquartered at 116, New Montgomery Street, Suite 300, San Francisco CA 94105, and
27 their presence and business activities within this judicial district.
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1 6. Venue is proper in this judicial district pursuant to 28 U.S.C. §§ 1391(b), 1391(c) and
2 1400(b).

3 7. This Court is vested with jurisdiction of this case pursuant to California Code Ann. Sec. 78A-
4 5-102(1). Venue is proper in this court pursuant to California Code Ann. 78B-3-304 and -
5 307.
6

7 **III. INTRADISTRICT ASSIGNMENT**

8 8. This lawsuit should be assigned to San Francisco Division of this Court because the San
9 Francisco Division covers San Mateo county, where Plaintiff lives.
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11 **IV. FACTS AND CAUSES OF ACTION**

12 **BACKGROUND**

13 9. On August 29, 2012, the United States Patent and Trademark Office duly and legally issued
14 U.S. Patent No. 8,271,339 ("the '339 Patent"), entitled "Method and Apparatus For Enabling
15 Real-Time, Bi-Directional Transactions On A Network." Dr. Arunachalam is the assignee of
16 all rights, title, and interest in the '339 Patent, including the right to recover damages for past
17 infringement. The priority date of the '339 patent is November 13, 1995. A copy of the '339
18 Patent is attached to the Complaint as Exhibit A.
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20 10. TRULIA provides real-estate web applications and services via electronic means accessible
21 at least through its website including, but not limited to the website <http://www.trulia.com>.
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23 **FIRST CAUSE OF ACTION: (INFRINGEMENT OF THE '339 PATENT)**

24 11. Plaintiff incorporates and re-alleges paragraphs 1- 12.

25 12. TRULIA has directly infringed and is continuing to infringe one or more claims of the '339
26 Patent by operating without authority one or more systems which are reflected in the website
27 <https://www.trinet.com>. Specifically, TRULIA infringed and infringes, because (i) it operated
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1 and continues to operate applications and software including, but not limited to, those
2 maintained on servers located in and/or accessible from the United States under TRULIA's
3 control that, as reflected in the website, *inter alia*, provide Point-of-Service applications to a
4 multi-media device over the World Wide Web, a server comprising memory and a processor
5 which comprise program instructions executable by the processor to implement Web
6 application transactions over the application layer of the OSI model; a Web server
7 programmed to deliver one of the website's Web pages displaying multiple Point-of-Service
8 applications on a multi-media device for access by a user, where the Point-of-Service
9 applications may be selected by the user to provide access to TRULIA's on line services,
10 and providing for two-way communication between TRULIA's on-line Web application and
11 the user; instructions for the Web server to hand over the user's request to access a Point-of-
12 Service application and to mediate the interactions between the user and the interface of
13 TRULIA's on line service during at least one real-time transaction being through a graphical
14 user interface displayed on the Web page on the user's multi-media device; component
15 connecting the Point of Service application on the web page to the on-line TRULIA's service
16 over the Web with instructions for allowing the user to bi-directionally retrieve data stored on
17 TRULIA's database and for writing data to the database in real-time, so that user and
18 TRULIA can perform a non-deferred transaction, and (ii) utilized and is utilizing computer
19 equipment, including, without limitation, computer equipment that stores, serves, and/or runs
20 the foregoing.

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25 13. Defendant's infringement has injured Plaintiff. Accordingly, Plaintiff is entitled to recover
26 damages adequate to compensate it for such infringement, but in no event less than a
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1 reasonable royalty, and an injunction to prohibit further infringement of the '339 Patent or
2 future compensation for use of the inventions.

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4 **14. PRAYER FOR RELIEF**

5 **15. WHEREFORE,** Plaintiff asks this Court to enter judgment against Defendant and against
6 Defendant's subsidiaries, affiliates, agents, servants, employees and all persons in active
7 concert or participation with them, granting the following relief:

8 A. An award of damages adequate to compensate Plaintiff for the infringement that
9 has occurred, together with prejudgment interest from the date infringement of the '339 Patent
10 began;

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12 B. An award to Plaintiff of all remedies available under 35 U.S.C. § 284;

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14 C. An award to Plaintiff of all remedies available under 35 U.S.C. § 285;

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16 D. A permanent injunction under 35 U.S.C. § 283 prohibiting further infringement of the
17 '339 Patent, and, in the alternative, in the event injunctive relief is not granted as
18 requested by Plaintiff, an award of a compulsory future royalty; and

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20 E. Such other and further relief as this Court or a jury may deem proper and just.

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22 **DEMAND FOR JURY TRIAL**

23 **16.** Plaintiff demands a jury trial on all issues.

24 **17.** Plaintiff incorporates paragraphs 1 through 18 in each Section above as if fully incorporated
25 therein.
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1 DATED: January 5, 2014

Respectfully submitted,

2 *Lakshmi Arunachalam*

3 Dr. Lakshmi Arunachalam

4 Individual and Owner of Patents-in-Suit

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Pro-Se Plaintiff

Dr. Lakshmi Arunachalam



US008271339B2

Exhibit A.

(12) **United States Patent**
Arunachalam

(10) **Patent No.:** **US 8,271,339 B2**
(45) **Date of Patent:** **Sep. 18, 2012**

(54) **METHOD AND APPARATUS FOR ENABLING
REAL-TIME BI-DIRECTIONAL
TRANSACTIONS ON A NETWORK**

(76) Inventor: **Lakshmi Arunachalam**, Menlo Park,
CA (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/932,758**

(22) Filed: **Mar. 4, 2011**

(65) **Prior Publication Data**
US 2011/0161202 A1 Jun. 30, 2011

Related U.S. Application Data

(60) Continuation-in-part of application No. 09/863,704,
filed on May 23, 2001, now Pat. No. 7,930,340, which
is a continuation-in-part of application No.
09/792,323, filed on Feb. 23, 2001, now Pat. No.
7,340,506, which is a continuation-in-part of
application No. 08/879,958, filed on Jun. 20, 1997,
now Pat. No. 5,987,500, which is a division of
application No. 08/700,726, filed on Aug. 5, 1996, now
Pat. No. 5,778,178.

(60) Provisional application No. 60/006,634, filed on Nov.
13, 1995.

(51) **Int. Cl.**
G06Q 30/00 (2012.01)

(52) **U.S. Cl.** **705/26; 705/27**

(58) **Field of Classification Search** **705/26;**
705/27, 26.1, 27.1

See application file for complete search history.

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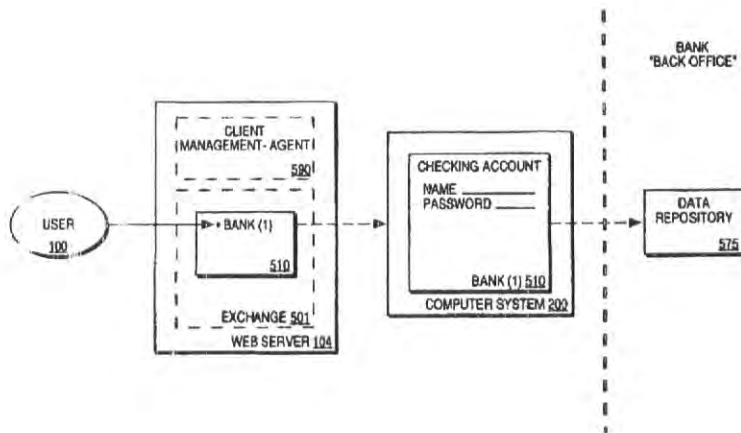
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Primary Examiner — James Zurita

(57) **ABSTRACT**

The present invention provides a method and apparatus for
providing real-time, two-way transactional capabilities on the
Web. Specifically, one embodiment of the present invention
discloses a method for enabling object routing, the method
comprising the steps of creating a virtual information store
containing information entries and attributes associating each
of the information entries and the attributes with an object
identity, and assigning a unique network address to each of
the object identities. A method is also disclosed for enabling
service management of the value-added network service, to
perform OAM&P functions on the services network.

14 Claims, 13 Drawing Sheets



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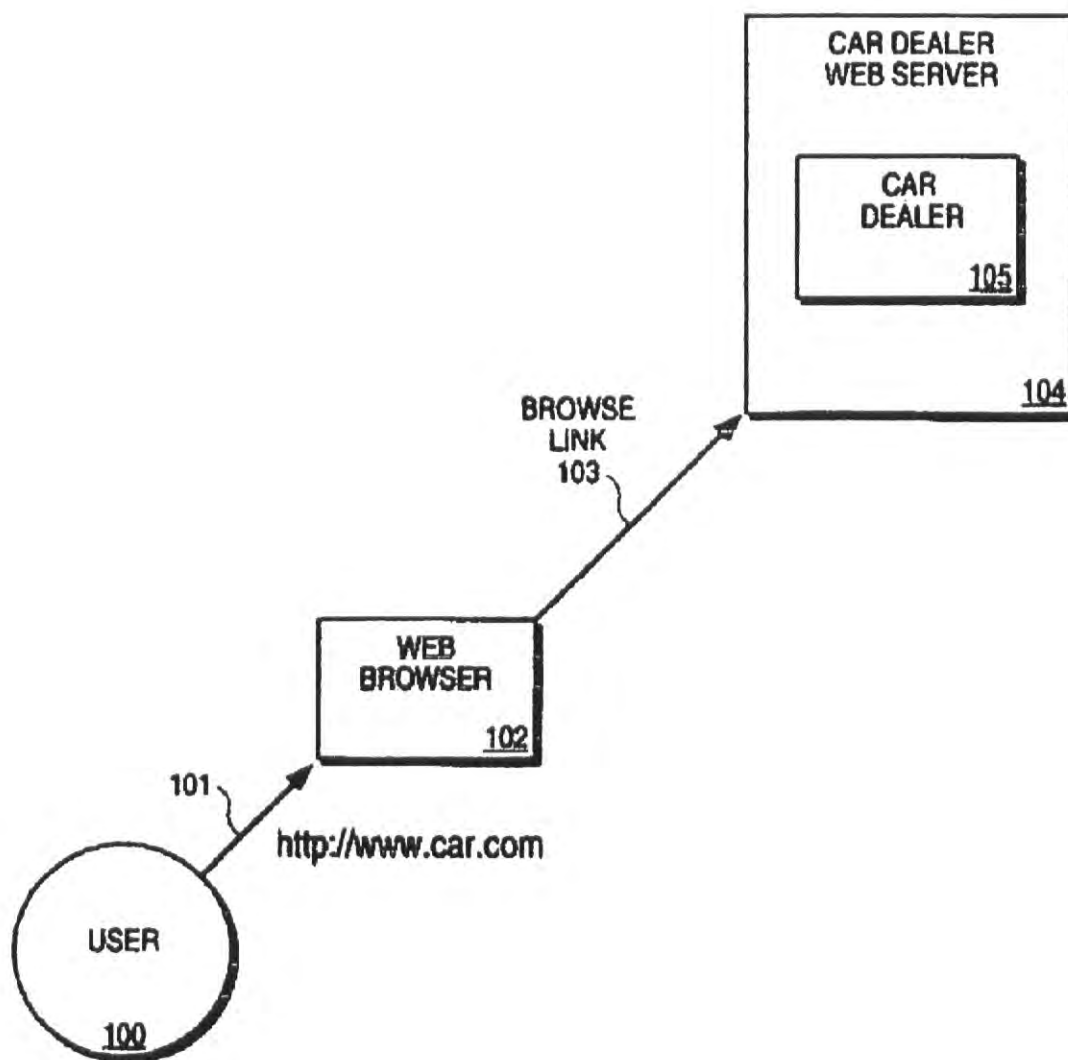
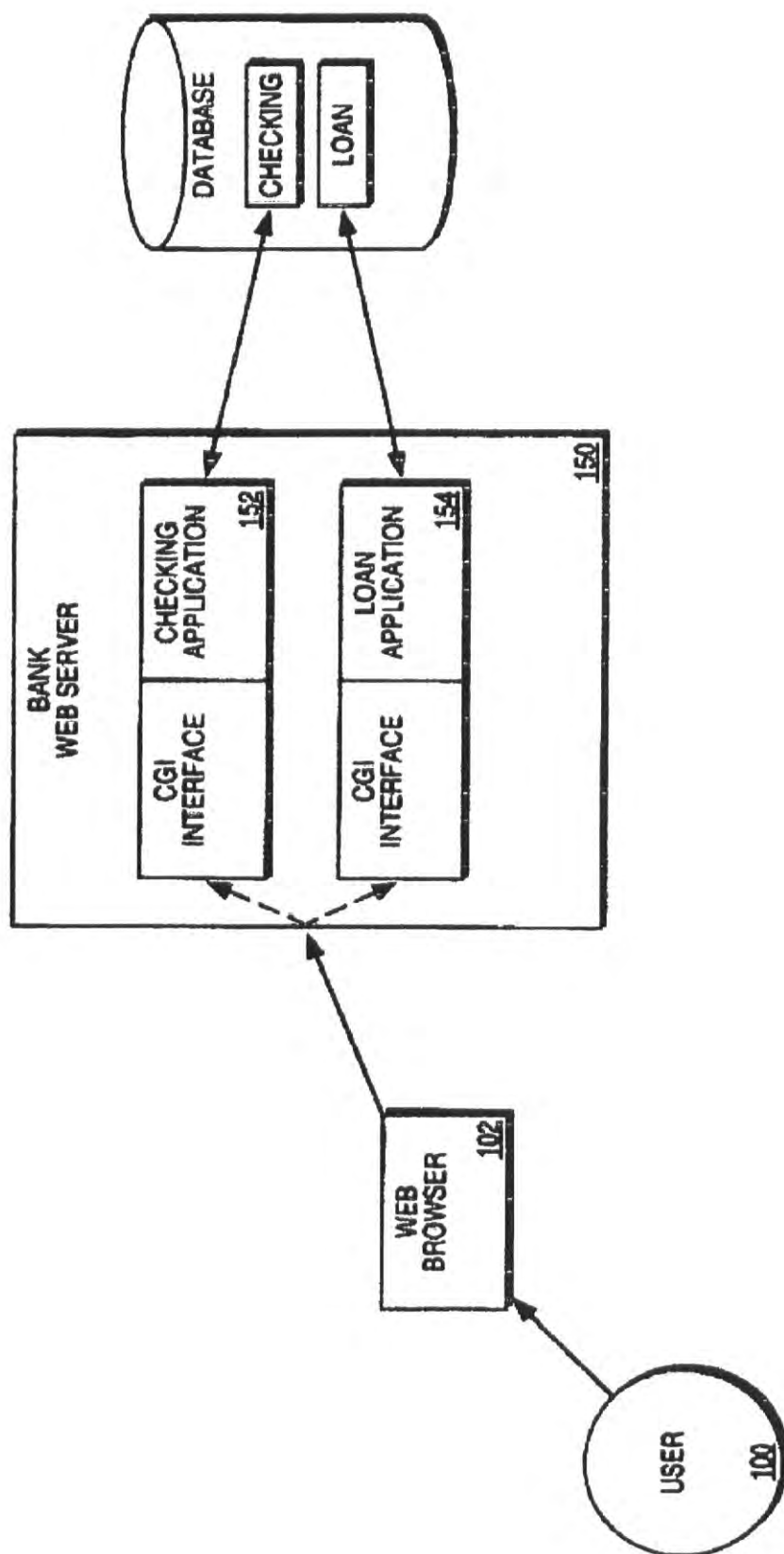
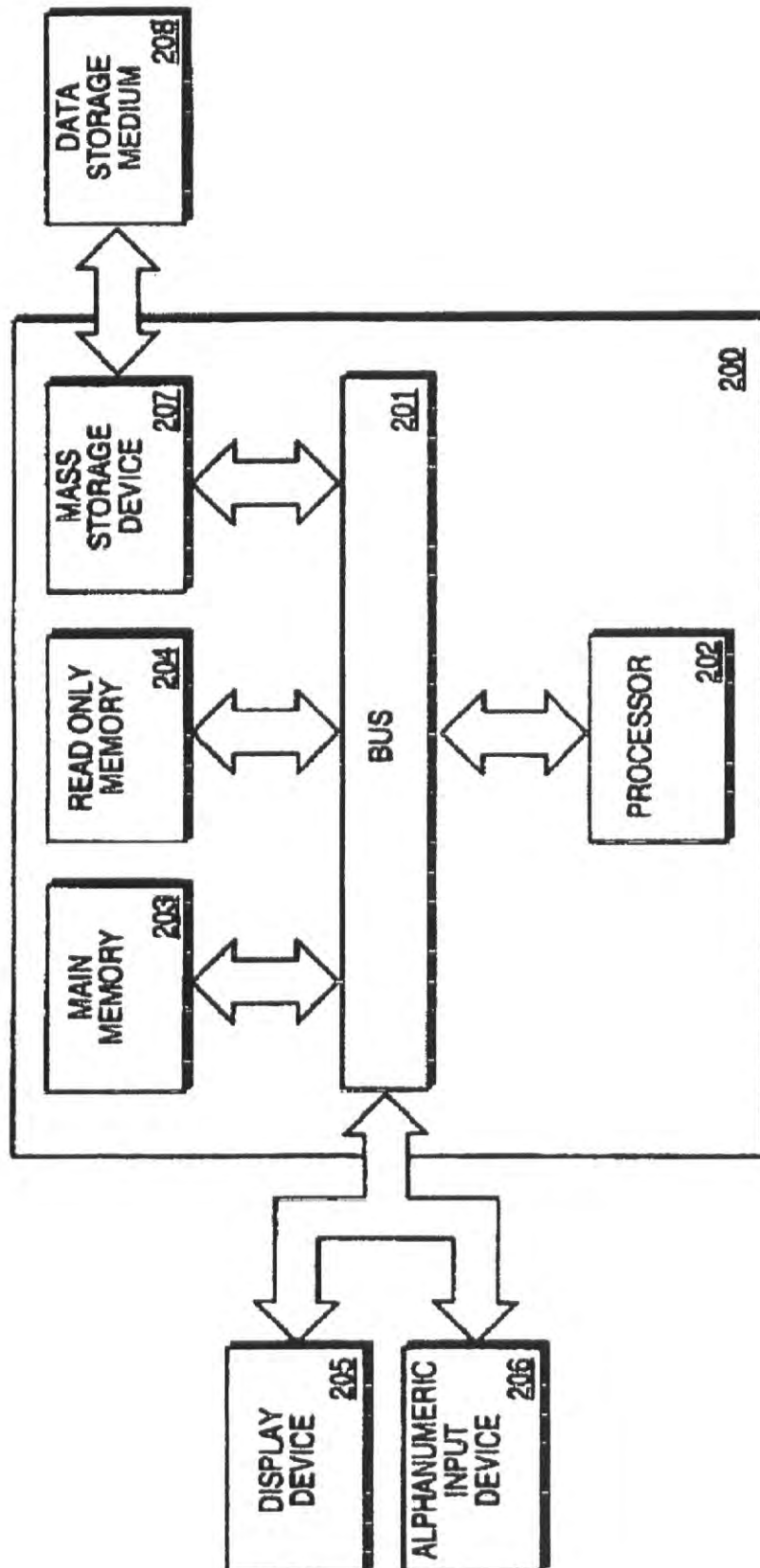


FIG. 1A (PRIOR ART)

**FIG. 1B** (PRIOR ART)

**FIG. 2**

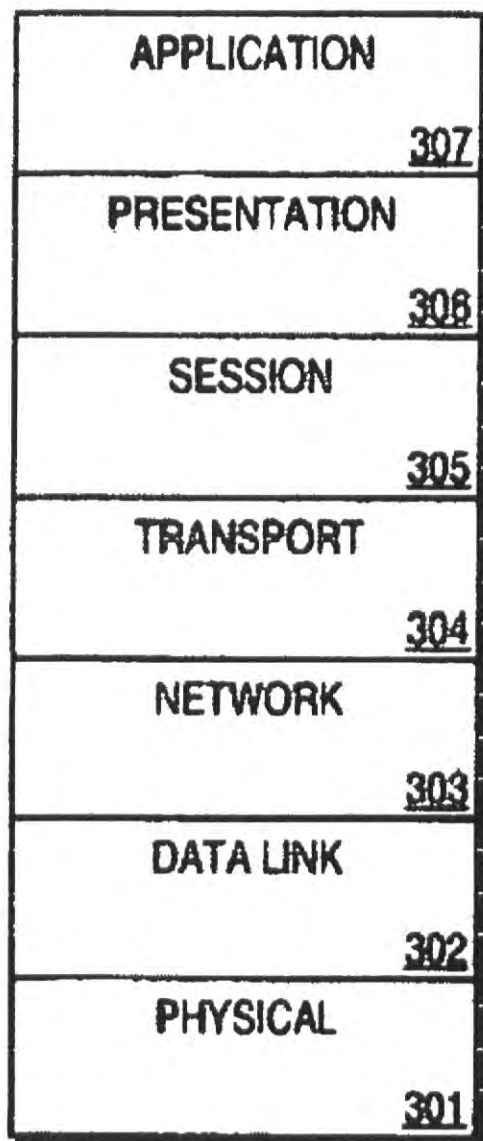
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OSI MODEL
300

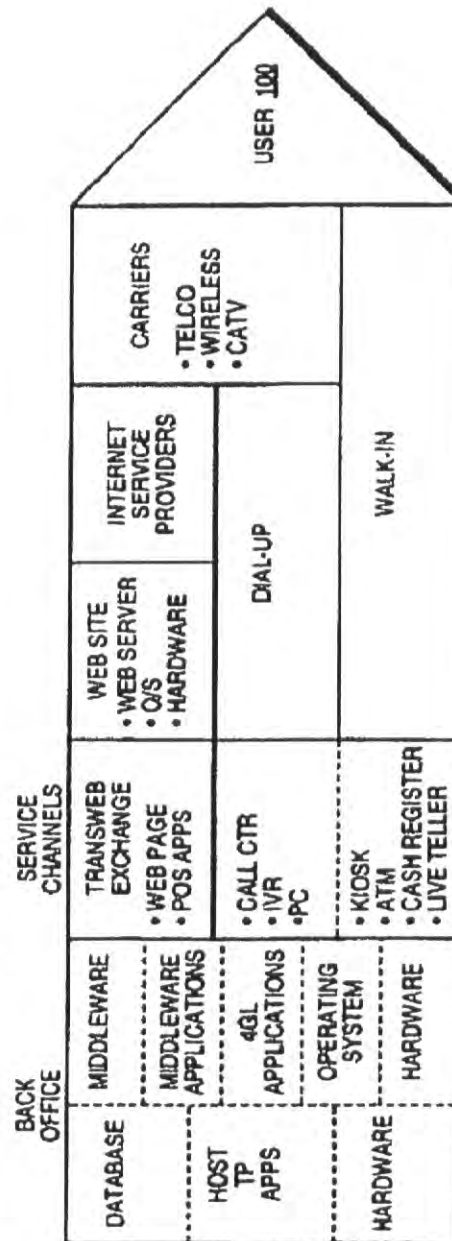
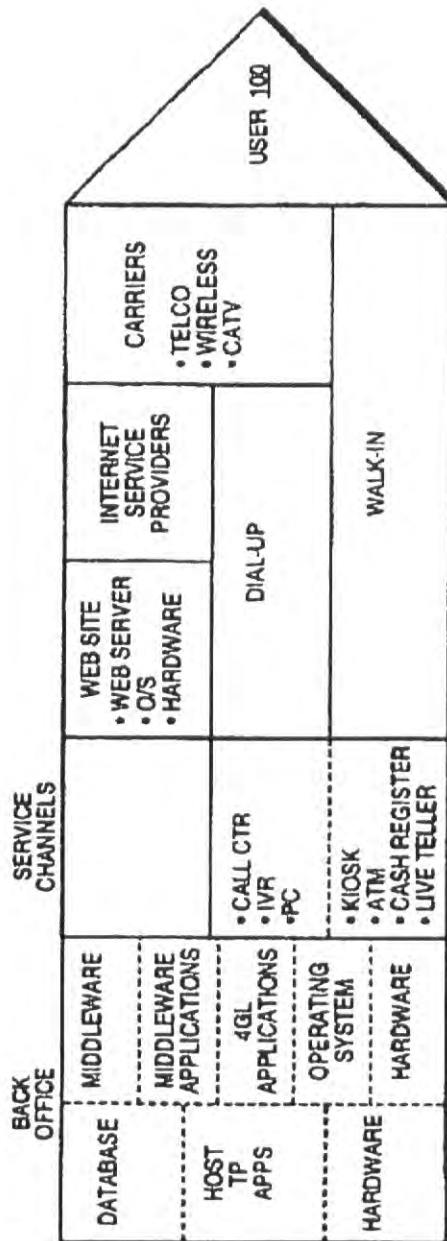
**FIG. 3**

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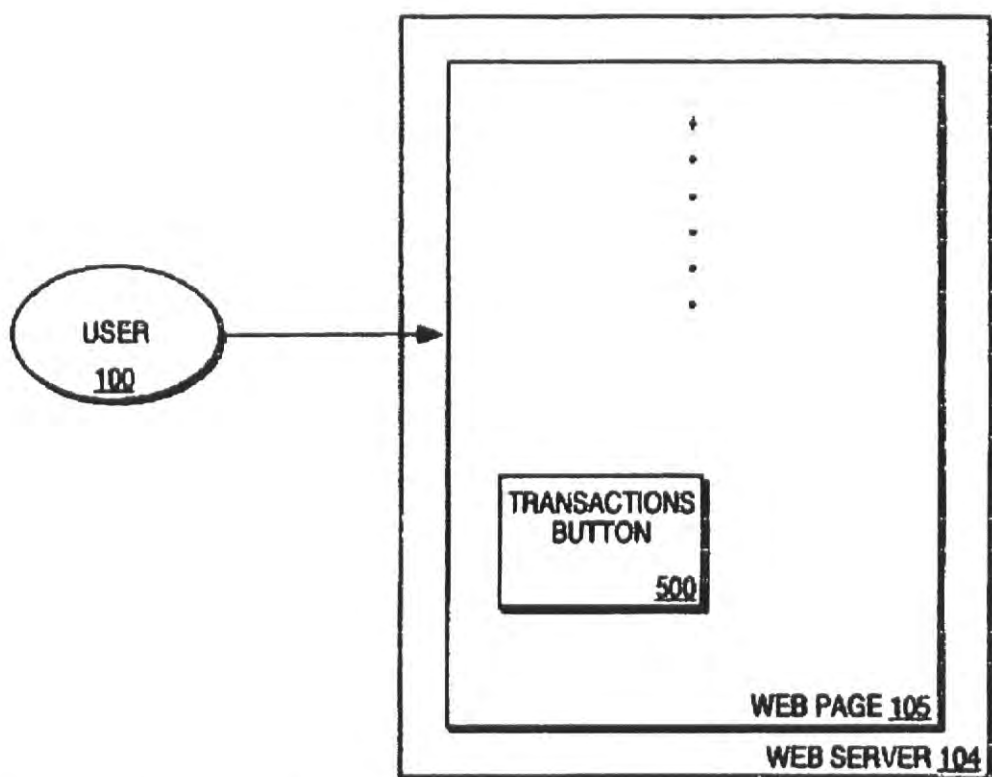
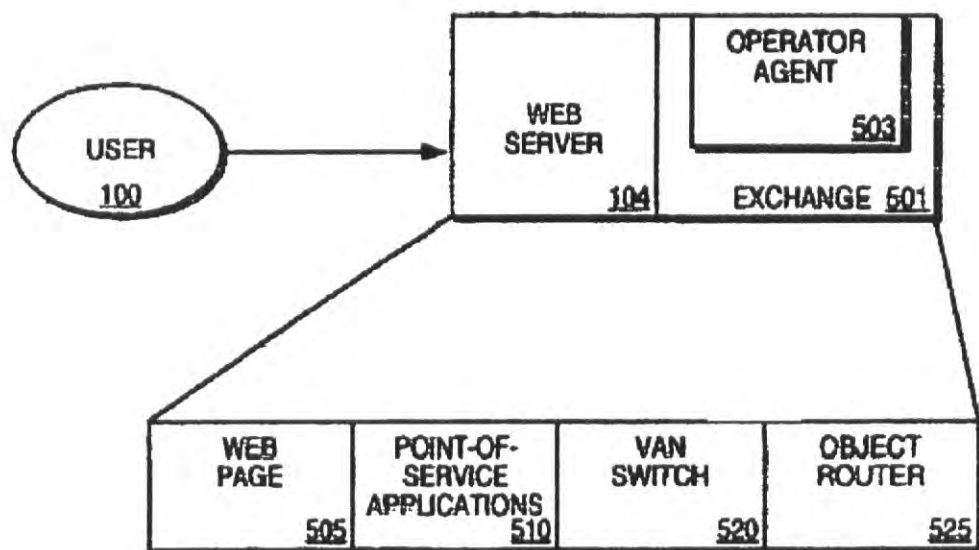


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**FIG. 5A****FIG. 5B**

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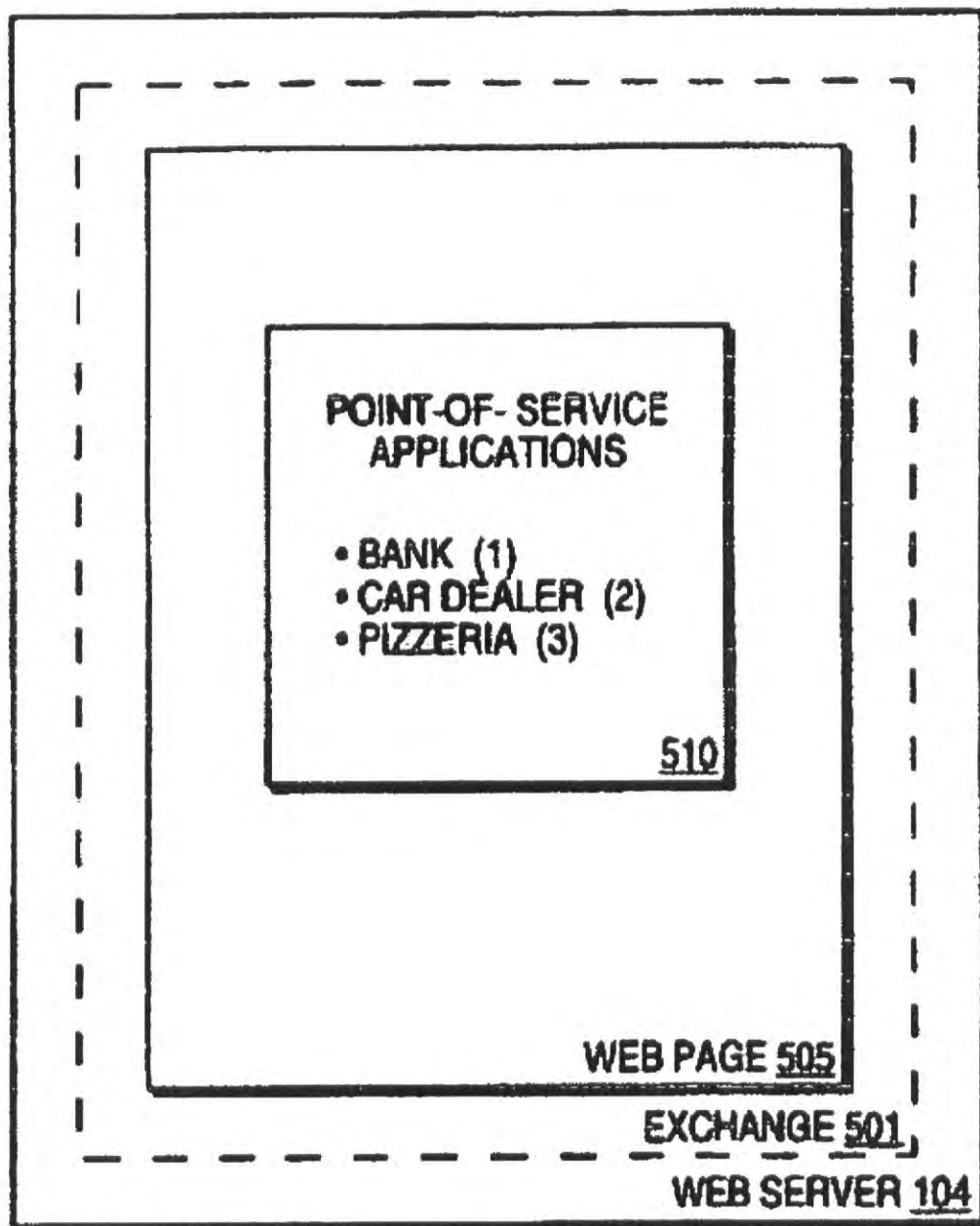


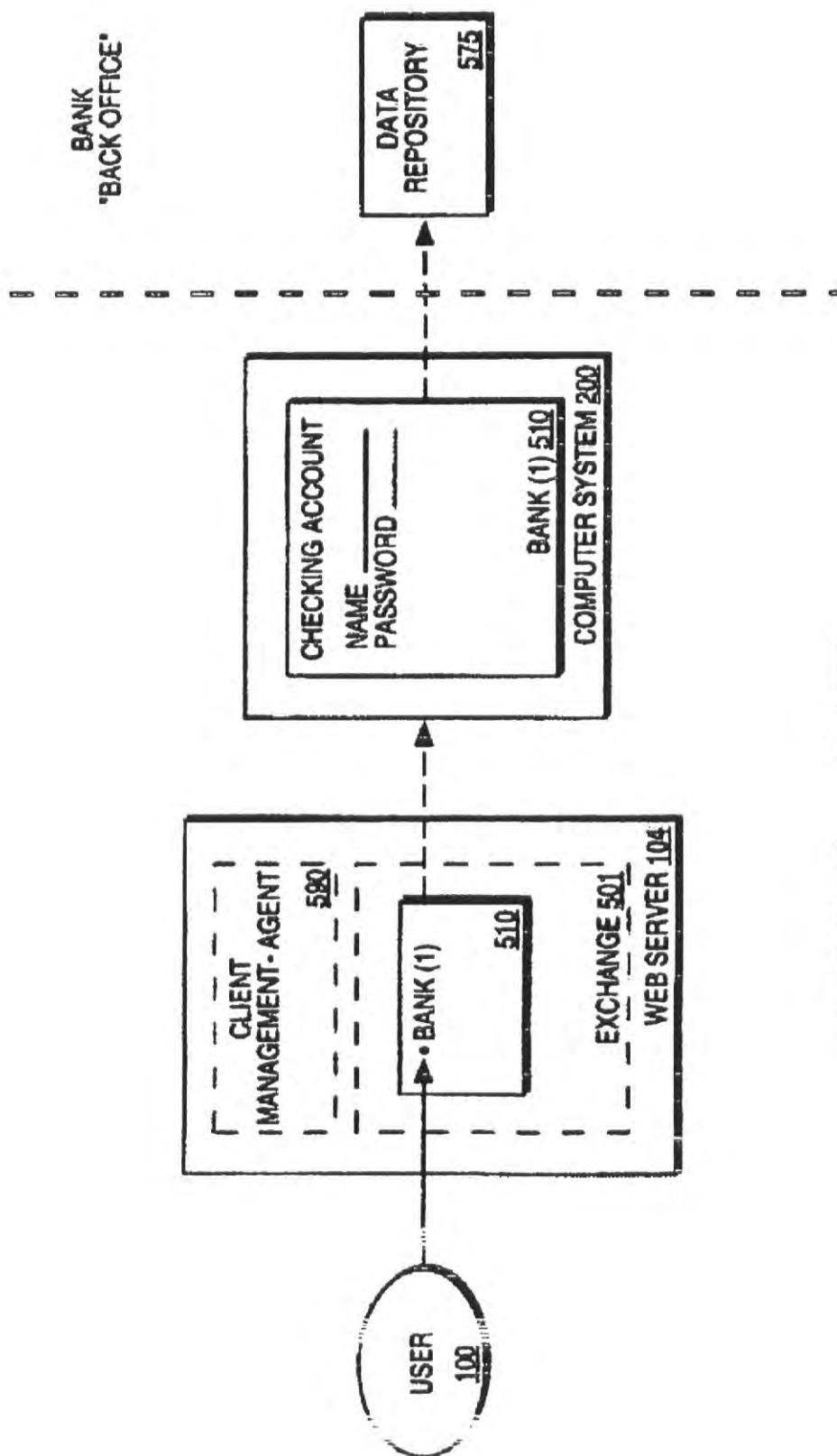
FIG. 5C

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**FIG. 5D**

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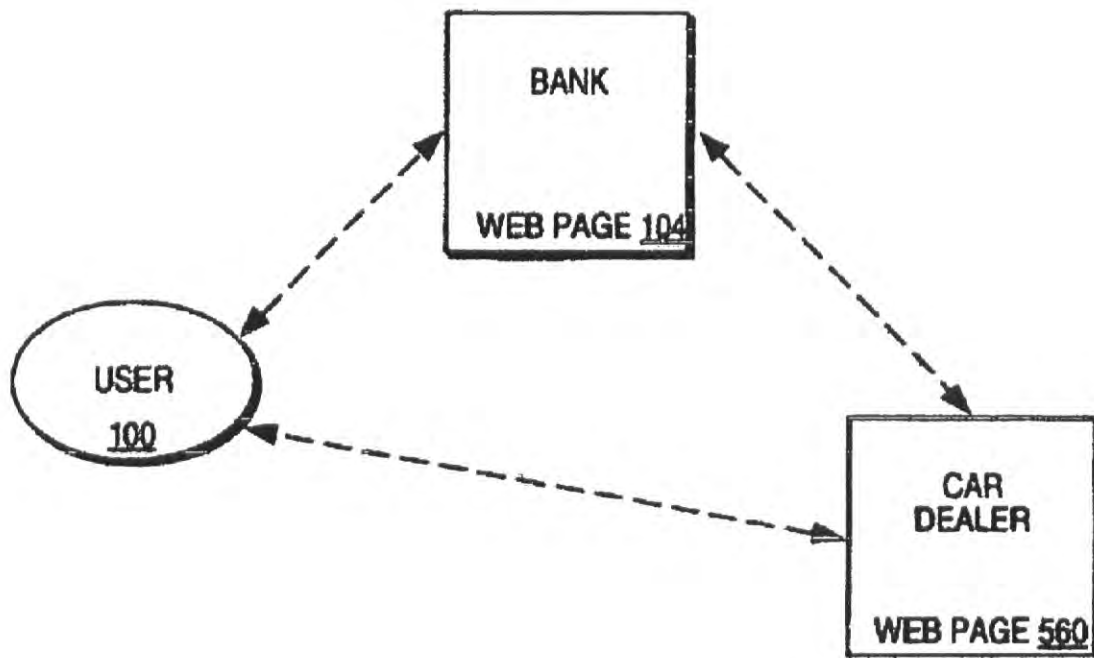


FIG. 5E

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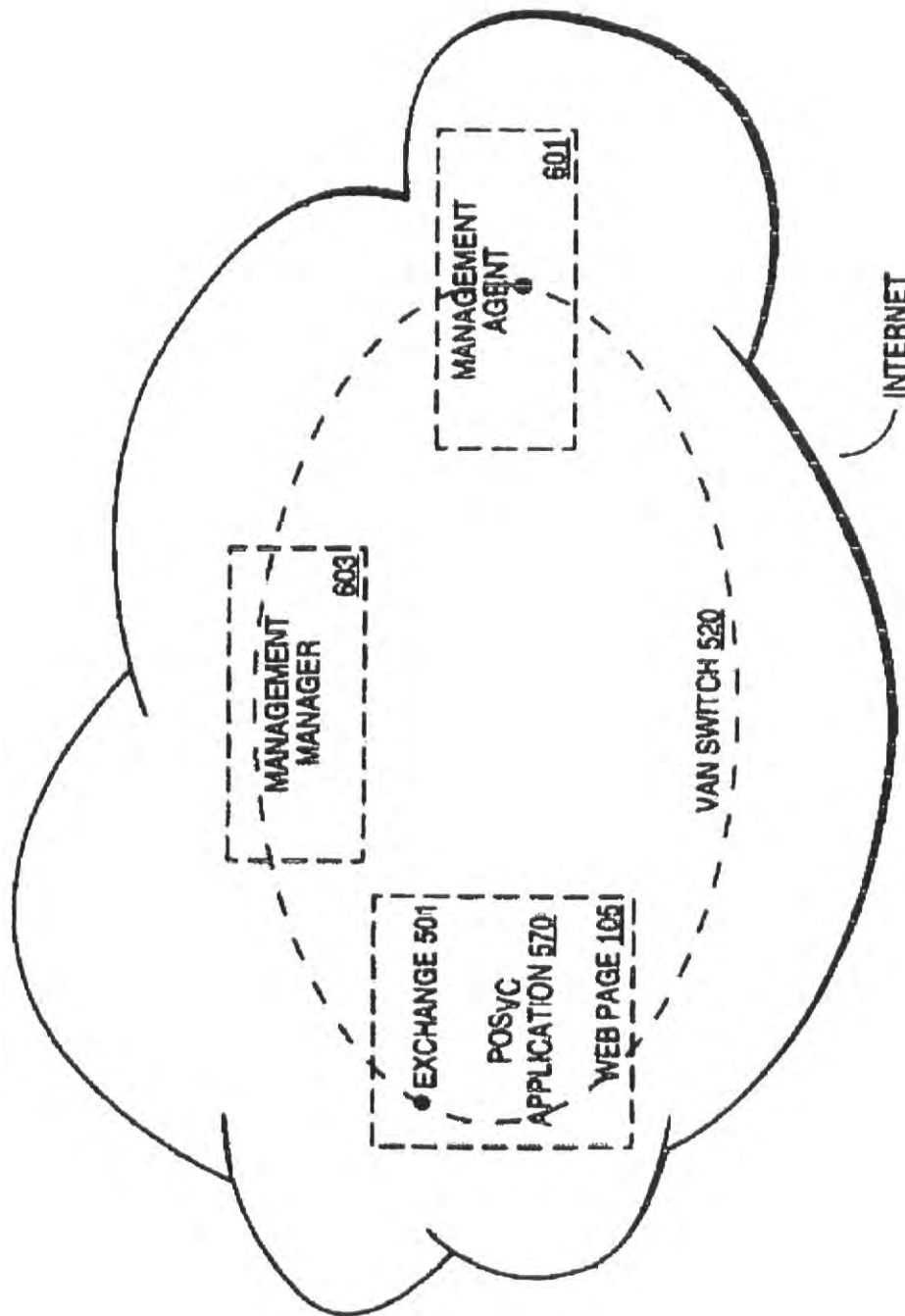


FIG. 6A

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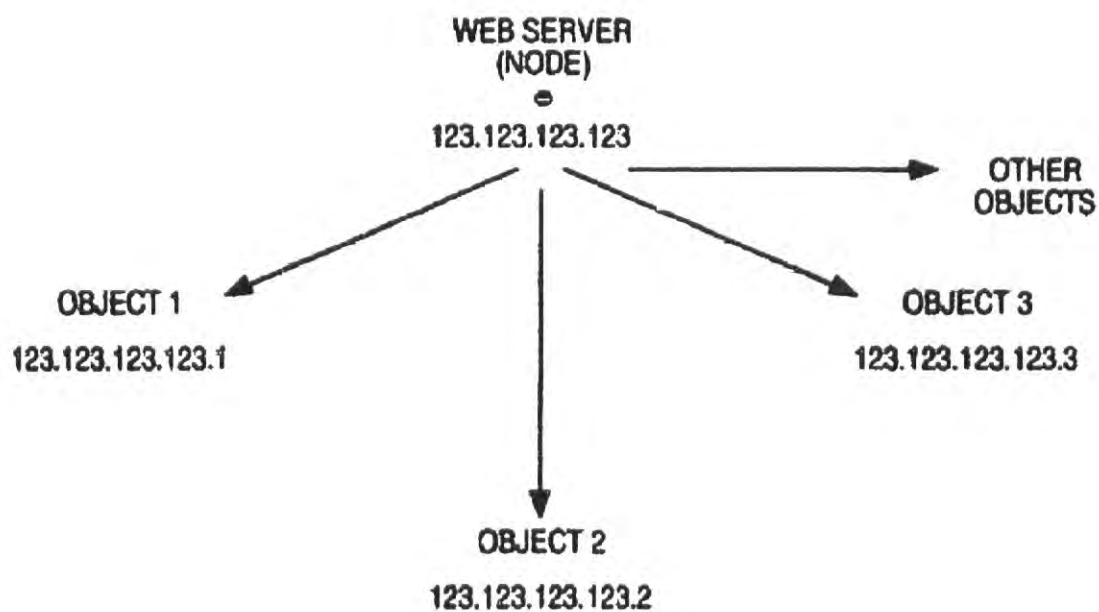


FIG. 6B

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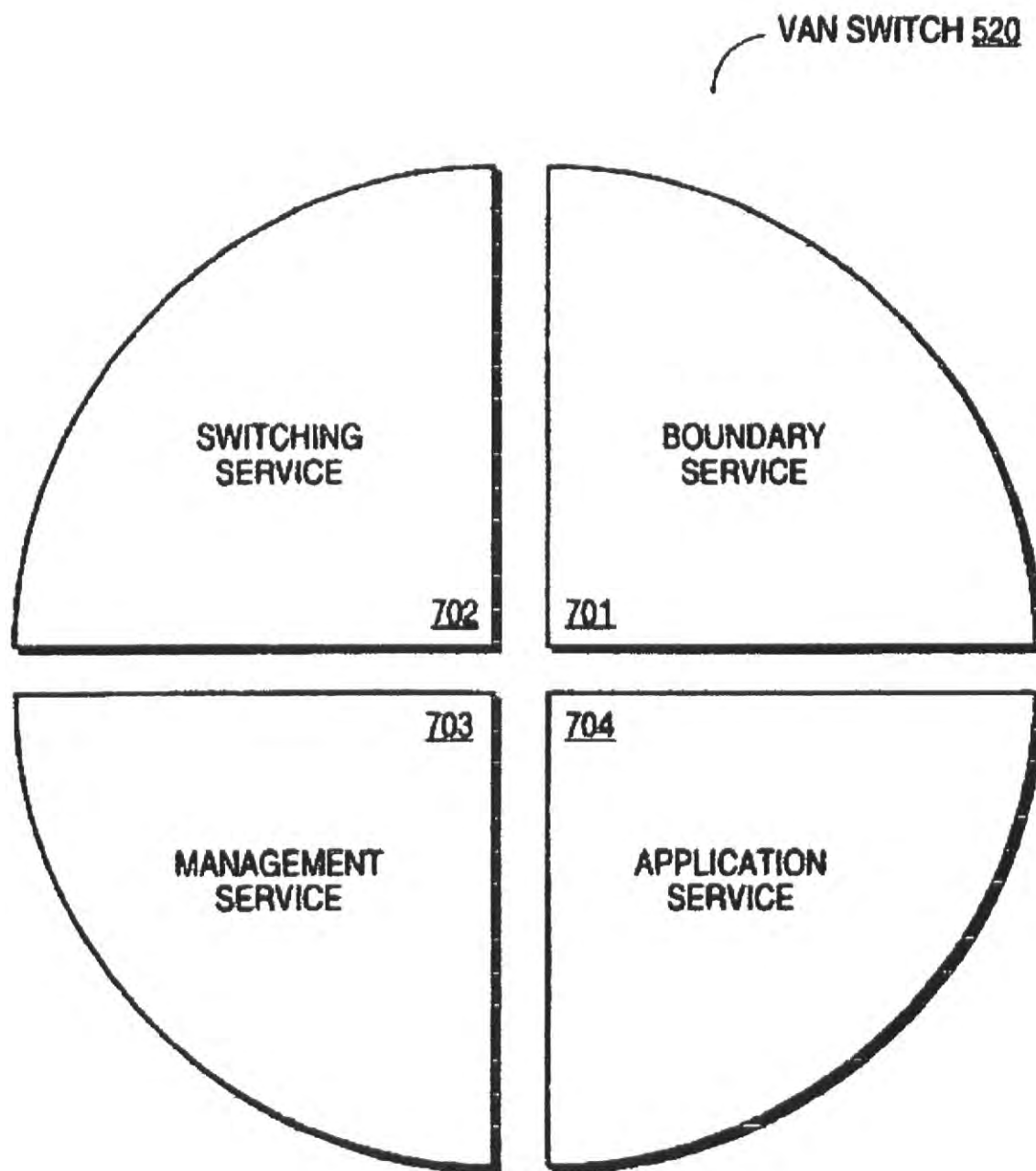


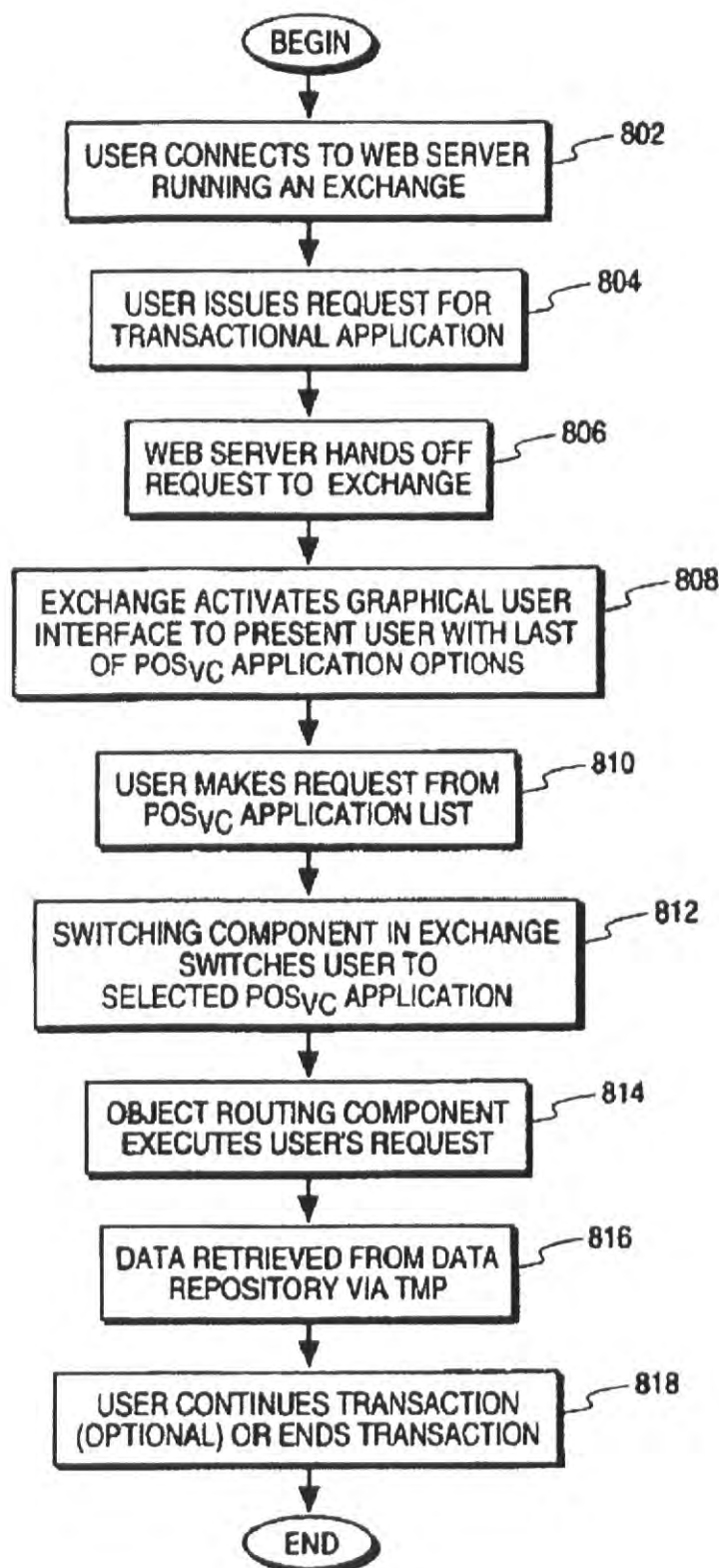
FIG. 7

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**FIG. 8**

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METHOD AND APPARATUS FOR ENABLING REAL-TIME BI-DIRECTIONAL TRANSACTIONS ON A NETWORK

This is a continuation-in-part of application Ser. No. 09/863,704 filed May 23, 2001 now U.S. Pat. No. 7,930,340 which was a continuation-in-part of application Ser. No. 09/792,323 filed Feb. 23, 2001, now U.S. Pat. No. 7,340,506, which was a continuation-in-part of application Ser. No. 08/879,958 filed Jun. 20, 1997, now U.S. Pat. No. 5,987,500, which was a divisional of application Ser. No. 08/700,726 filed Aug. 5, 1996, now U.S. Pat. No. 5,778,178, which was related to and claimed priority from provisional application No. 60/006,634 filed Nov. 13, 1995. Application Ser. Nos. 09/863,704, 09/792,323, 08/879,958, 08/700,726 and 60/006,634 are hereby incorporated by reference.

In addition related application Ser. Nos. 12/628,060 filed Nov. 30, 2009, 12/628,066 filed Nov. 30, 2009, 12/628,068 filed Nov. 30, 2009, 12/628,069 filed Nov. 30, 2009, 11/980,185 filed Oct. 30, 2007, 09/296,207 filed Apr. 21, 1999 and provisional application 60/206,422 filed May 23, 2000 are also all hereby incorporated by reference.

The text of this application is substantially similar to that of application Ser. No. 08/700,726, now U.S. Pat. No. 5,778,178.

BACKGROUND

1. Field of the Invention

The present invention relates to the area of Internet communications. Specifically, the present invention relates to a method and apparatus for configurable value-added network switching and object routing.

2. Background of the Invention

With the Internet and the World Wide Web ("the Web") evolving rapidly as a viable consumer medium for electronic commerce, new on-line services are emerging to fill the needs of on-line users. An Internet user today can browse on the Web via the use of a Web browser. Web browsers are software interfaces that run on Web clients to allow access to Web servers via a simple user interface. A Web user's capabilities today from a Web browser are, however, extremely limited. The user can perform one-way, browse-only interactions. Additionally, the user has limited "deferred" transactional capabilities, namely electronic mail (e-mail) capabilities. E-mail capabilities are referred to as "deferred transactions" because the consumer's request is not processed until the e-mail is received, read, and the person or system reading the e-mail executes the transaction. This transaction is thus not performed in real-time.

FIG. 1A illustrates typical user interactions on the Web today. User 100 sends out a request from Web browser 102 in the form of a universal resource locator (URL) 101 in the following manner: <http://www.car.com>. URL 101 is processed by Web browser 102 that determines the URL corresponds to car dealer Web page 105, on car dealer Web server 104. Web browser 102 then establishes browse link 103 to car dealer Web page 105. User 100 can browse Web page 105 and select "hot links" to jump to other locations in Web page 105, or to move to other Web pages on the Web. This interaction is typically a browse-only interaction. Under limited circumstances, the user may be able to fill out a form on car dealer Web page 105, and e-mail the form to car dealer Web server 104. This interaction is still strictly a one-way browse mode communications link, with the e-mail providing limited, deferred transactional capabilities.

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Under limited circumstances, a user may have access to two-way services on the Web via Common Gateway Interface (CGI) applications. CGI is a standard interface for running external programs on a Web server. It allows Web servers to create documents dynamically when the server receives a request from the Web browser. When the Web server receives a request for a document, the Web server dynamically executes the appropriate CGI script and transmits the output of the execution back to the requesting Web browser. This interaction can thus be termed a "two-way" transaction. It is a severely limited transaction, however, because each CGI application is customized for a particular type of application or service.

For example, as illustrated in FIG. 1B, user 100 may access bank 150's Web server and attempt to perform transactions on checking account 152 and to make a payment on loan account 154. In order for user 100 to access checking account 152 and loan account 154 on the Web, CGI application scripts must be created for each account, as illustrated in FIG. 1B. The bank thus has to create individual scripts for each of its services to offer users access to these services. User 100 can then interact in a limited fashion with these individual applications. Creating and managing individual CGI scripts for each service is not a viable solution for merchants with a large number of services.

As the Web expands and electronic commerce becomes more desirable, the need increases for robust, real-time, bi-directional transactional capabilities on the Web. A true real-time, bi-directional transaction would allow a user to connect to a variety of services on the Web, and perform real-time transactions on those services. For example, although user 100 can browse car dealer Web page 105 today, the user cannot purchase the car, negotiate a car loan or perform other types of real-time, two-way transactions that he can perform with a live salesperson at the car dealership. Ideally, user 100 in FIG. 1A would be able to access car dealer Web page 105, select specific transactions that he desires to perform, such as purchase a car, and perform the purchase in real-time, with two-way interaction capabilities. CGI applications provide user 100 with a limited ability for two-way interaction with car dealer Web page 105, but due to the lack of interaction and management between the car dealer and the bank, he will not be able to obtain a loan and complete the purchase of the car via a CGI application. The ability to complete robust real-time, two-way transactions is thus not truly available on the Web today.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method and apparatus for providing real-time, two-way transactional capabilities on the Web. Specifically, one embodiment of the present invention discloses a configurable value-added network switch for enabling real-time transactions on the World Wide Web. The configurable value added network switch comprises means for switching to a transactional application in response to a user specification from a World Wide Web application, means for transmitting a transaction request from the transactional application, and means for processing the transaction request.

According to another aspect of the present invention, a method and apparatus for enabling object routing on the World Wide Web is disclosed. The method for enabling object routing comprises the steps of creating a virtual information store containing information entries and attributes, associat-

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ing each of the information entries and the attributes with an object identity, and assigning a unique network address to each of the object identities.

Other objects, features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description of the present invention as set forth below.

FIG. 1A is an illustration of a current user's browse capabilities on the Web via a Web browser.

FIG. 1B is an illustration of a current user's capabilities to perform limited transactions on the Web via CGI applications.

FIG. 2 illustrates a typical computer system on which the present invention may be utilized.

FIG. 3 illustrates the Open Systems Interconnection (OSI) Model.

FIG. 4A illustrates conceptually the user value chain as it exists today.

FIG. 4B illustrates one embodiment of the present invention.

FIG. 5A illustrates a user accessing a Web server including one embodiment of the present invention.

FIG. 5B illustrates the exchange component according to one embodiment of the present invention.

FIG. 5C illustrates an example of a point-of-service (POSvc) application list.

FIG. 5D illustrates a user selecting a bank POSvc application from the POSvc application list.

FIG. 5E illustrates a three-way transaction according to one embodiment of the present invention.

FIG. 6A illustrates a value-added network (VAN) switch.

FIG. 6B illustrates the hierarchical addressing tree structure of the networked objects in DOLSIBs.

FIG. 7 illustrates conceptually the layered architecture of a VAN switch.

FIG. 8 is a flow diagram illustrating one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a method and apparatus for configurable value-added network switching and object routing and management. "Web browser" as used in the context of the present specification includes conventional Web browsers such as NCSA Mosaic™ from NCSA and Netscape Mosaic™ from Netscape™. The present invention is independent of the Web browser being utilized and the user can use any Web browser, without modifications to the Web browser. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent to one of ordinary skill in the art, however, that these specific details need not be used to practice the present invention. In other instances, well-known structures, interfaces and processes have not been shown in detail in order not to unnecessarily obscure the present invention.

FIG. 2 illustrates a typical computer system 200 in which the present invention operates. The preferred embodiment of the present invention is implemented on an IBM™ Personal Computer manufactured by IBM Corporation of Armonk,

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N.Y. Alternate embodiments may be implemented on a Macintosh™ computer manufactured by Apple™ Computer, Incorporated of Cupertino, Calif. It will be apparent to those of ordinary skill in the art that other alternative computer system architectures may also be employed.

In general, such computer systems as illustrated by FIG. 2 comprise a bus 201 for communicating information, a processor 202 coupled with the bus 201 for processing information, main memory 203 coupled with the bus 201 for storing information and instructions for the processor 202, a read-only memory 204 coupled with the bus 201 for storing static information and instructions for the processor 202, a display device 205 coupled with the bus 201 for displaying information for a computer user, an input device 206 coupled with the bus 201 for communicating information and command selections to the processor 202, and a mass storage device 207, such as a magnetic disk and associated disk drive, coupled with the bus 201 for storing information and instructions. A data storage medium 208 containing digital information is configured to operate with mass storage device 207 to allow processor 202 access to the digital information on data storage medium 208 via bus 201.

Processor 202 may be any of a wide variety of general purpose processors or microprocessors such as the Pentium™ microprocessor manufactured by Intel™ Corporation or the Motorola™ 68040 or Power PC™ brand microprocessor manufactured by Motorola™ Corporation. It will be apparent to those of ordinary skill in the art, however, that other varieties of processors may also be used in a particular computer system. Display device 205 may be a liquid crystal device, cathode ray tube (CRT), or other suitable display device. Mass storage device 207 may be a conventional hard disk drive, floppy disk drive, CD-ROM drive, or other magnetic or optical data storage device for reading and writing information stored on a hard disk, a floppy disk, a CD-ROM a magnetic tape, or other magnetic or optical data storage medium. Data storage medium 208 may be a hard disk, a floppy disk, a CD-ROM, a magnetic tape, or other magnetic or optical data storage medium.

In general, processor 202 retrieves processing instructions and data from a data storage medium 208 using mass storage device 207 and downloads this information into random access memory 203 for execution. Processor 202, then executes an instruction stream from random access memory 203 or read-only memory 204. Command selections and information input at input device 206 are used to direct the flow of instructions executed by processor 202. Equivalent input device 206 may also be a pointing device such as a conventional mouse or trackball device. The results of this processing execution are then displayed on display device 205.

The preferred embodiment of the present invention is implemented as a software module, which may be executed on a computer system such as computer system 200 in a conventional manner. Using well known techniques, the application software of the preferred embodiment is stored on data storage medium 208 and subsequently loaded into and executed within computer system 200. Once initiated, the software of the preferred embodiment operates in the manner described below.

FIG. 3 illustrates the Open Systems Interconnection (OSI) reference model. OSI Model 300 is an international standard that provides a common basis for the coordination of standards development, for the purpose of systems interconnection. The present invention is implemented to function as a routing switch within the "application layer" of the OSI model. The model defines seven layers, with each layer com-

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communicating with its peer layer in another node through the use of a protocol. Physical layer **301** is the lowest layer, with responsibility to transmit unstructured bits across a link. Data link layer **302** is the next layer above physical layer **301**. Data link layer **302** transmits chunks across the link and deals with problems like checksumming to detect data corruption, orderly coordination of the use of shared media and addressing when multiple systems are reachable. Network bridges operate within data link layer **302**.

Network layer **303** enables any pair of systems in the network to communicate with each other. Network layer **303** contains hardware units such as routers, that handle routing, packet fragmentation and reassembly of packets. Transport layer **304** establishes a reliable communication stream between a pair of systems, dealing with errors such as lost packets, duplicate packets, packet reordering and fragmentation. Session layer **305** offers services above the simple communication stream provided by transport layer **304**. These services include dialog control and chaining. Presentation layer **306** provides a means by which OSI compliant applications can agree on representations for data. Finally, application layer **307** includes services such as file transfer, access and management services (FTAM), electronic mail and virtual terminal (VT) services. Application layer **307** provides a means for application programs to access the OSI environment. As described above, the present invention is implemented to function as a routing switch in application layer **307**. Application layer routing creates an open channel for the management, and the selective flow of data from remote databases on a network.

A. Overview

FIG. 4A illustrates conceptually the user value chain as it exists today. The user value chain in FIG. 4A depicts the types of transactions that are performed today, and the channels through which the transactions are performed. A "transaction" for the purposes of the present invention includes any type of commercial or other type of interaction that a user may want to perform. Examples of transactions include a deposit into a bank account, a request for a loan from a bank, a purchase of a car from a car dealership or a purchase of a car with financing from a bank. A large variety of other transactions are also possible.

A typical user transaction today may involve user **100** walking into a bank or driving up to a teller machine, and interacting with a live bank teller, or automated teller machine (ATM) software applications. Alternatively, user **100** can perform the same transaction by using a personal computer (PC), activating application software on his PC to access his bank account, and dialing into the bank via a modem line. If user **100** is a Web user, however, there is no current mechanism for performing a robust, real-time transaction with the bank, as illustrated in FIG. 4A. CGI scripts provide only limited two-way capabilities, as described above. Thus, due to this lack of a robust mechanism by which real-time Web transactions can be performed, the bank is unable to be a true "Web merchant," namely a merchant capable of providing complete transactional services on the Web.

According to one embodiment of the present invention, as illustrated in FIG. 4B, each merchant that desires to be a Web merchant can provide real-time transactional capabilities to users who desire to access the merchants' services via the Web. This embodiment includes a service network running on top of a facilities network, namely the Internet, the Web or e-mail networks. For the purposes of this application, users are described as utilizing PC's to access the Web via Web server "switching" sites. (Switching is described in more detail below). Users may also utilize other personal devices

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such as network computers or cellular devices to access the merchants' services via appropriate switching sites. These switching sites include non-Web network computer sites and cellular provider sites. Five components interact to provide this service network functionality, namely an exchange, an operator agent, a management agent, a management manager and a graphical user interface. All five components are described in more detail below.

As illustrated in FIG. 5A, user **100** accesses Web server **104**. Having accessed Web server **104**, user **100** can decide that he desires to perform real-time transactions. When Web server **104** receives user **100**'s indication that he desires to perform real-time transactions, the request is handed over to an exchange component. Thus, from Web page **105**, for example, user **100** can select button **500**, entitled "Transactions" and Web server **104** hands user **100**'s request over to the exchange component. The button and the title can be replaced by any mechanism that can instruct a Web server to hand over the consumer's request to the exchange component.

FIG. 5B illustrates exchange **501**. Exchange **501** comprises Web page **505** and point-of-service (POSvc) applications **510**. Exchange **501** also conceptually includes a switching component and an object routing component (described in more detail below). POSvc applications **510** are transactional applications, namely applications that are designed to incorporate and take advantage of the capabilities provided by the present invention. Although exchange **501** is depicted as residing on Web server **104**, the exchange can also reside on a separate computer system that resides on the Internet and has an Internet address. Exchange **501** may also include operator agent **503** that interacts with a management manager (described in more detail below). Exchange **501** creates and allows for the management (or distributed control) of a service network, operating within the boundaries of an IP-based facilities network. Thus, exchange **501** and a management agent component, described in more detail below, under the headings "VAN Switch and Object Routing," together perform the switching, object routing, application and service management functions according to one embodiment of the present invention.

Exchange **501** processes the consumer's request and displays an exchange Web page **505** that includes a list of POSvc applications **510** accessible by exchange **501**. A POSvc application is an application that can execute the type of transaction that the user may be interested in performing. The POSvc list is displayed via the graphical user interface component. One embodiment of the present invention supports Hyper-Text Markup Language as the graphical user interface component. Virtual Reality Markup Language and Java™ are also supported by this embodiment. A variety of other graphical user interface standards can also be utilized to implement the graphical user interface.

An example of a POSvc application list is illustrated in FIG. 5C. User **100** can thus select from POSvc applications Bank **510(1)**, Car Dealer **510(2)** or Pizzeria **510(3)**. Numerous other POSvc applications can also be included in this selection. If user **100** desires to perform a number of banking transactions, and selects the Bank application, a Bank POSvc application will be activated and presented to user **100**, as illustrated in FIG. 5D. For the purposes of illustration, exchange **501** in FIG. 5D is shown as running on a different computer system (Web server **104**) from the computer systems of the Web merchants running POSvc applications (computer system **200**). Exchange **501** may, however, also be on the same computer system as one or more of the computer systems of the Web merchants.

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Once Bank POSvc application 510 has been activated, user 100 will be able to connect to Bank services and utilize the application to perform banking transactions, thus accessing data from a host or data repository 575 in the Bank "Back Office." The Bank Back Office comprises legacy databases and other data repositories that are utilized by the Bank to store its data. This connection between user 100 and Bank services is managed by exchange 501. As illustrated in FIG. 5D, once the connection is made between Bank POSvc application 510(1), for example, and Bank services, an operator agent on Web server 104 may be activated to ensure the availability of distributed functions and capabilities.

Each Web merchant may choose the types of services that it would like to offer its clients. In this example, if Bank decided to include in their POSvc application access to checking and savings accounts, user 100 will be able to perform real-time transactions against his checking and savings accounts. Thus, if user 100 moves \$500 from his checking account into his savings account, the transaction will be performed in real-time, in the same manner the transaction would have been performed by a live teller at the bank or an ATM machine. Therefore, unlike his prior access to his account, user 100 now has the capability to do more than browse his bank account. The ability to perform these types of robust, real-time transactions from a Web client is a significant aspect of the present invention.

Bank can also decide to provide other types of services in POSvc application 510(1). For example, Bank may agree with Car dealership to allow Bank customers to purchase a car from that dealer, request a car loan from Bank, and have the entire transaction performed on the Web, as illustrated in FIG. 5E. In this instance, the transactions are not merely two-way, between the user and Bank, but three-way, amongst the consumer, Bank and Car dealership. According to one aspect of the present invention, this three-way transaction can be expanded to n-way transactions, where n represents a predetermined number of merchants or other service providers who have agreed to cooperate to provide services to users. The present invention therefore allows for "any-to-any" communication and transactions on the Web, thus facilitating a large, flexible variety of robust, real-time transactions on the Web.

Finally, Bank may also decide to provide intra-merchant or intra-bank services, together with the inter-merchant services described above. For example, if Bank creates a POSvc application for use by the Bank Payroll department, Bank may provide its own employees with a means for submitting timecards for payroll processing by the Bank's Human Resources (HR) Department. An employee selects the Bank HR POSvc application, and submits his timecard. The employee's timecard is processed by accessing the employee's payroll information, stored in the Bank's Back Office. The transaction is thus processed in real-time, and the employee receives his paycheck immediately.

B. Van Switching and Object Routing

As described above, exchange 501 and management agent 601, illustrated in FIG. 6A, together constitute a value-added network (VAN) switch. These two elements may take on different roles as necessary, including peer-to-peer, client-server or master-slave roles. Management manager 603 is illustrated as residing on a separate computer system on the Internet. Management manager 603 can, however, also reside on the same machine as exchange 501. Management manager 603 interacts with the operator agent 503 residing on exchange 501.

VAN switch 520 provides multi-protocol object routing, depending upon the specific VAN services chosen. This multi-protocol object routing is provided via a proprietary

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protocol, TransWeb™ Management Protocol (TMP). TMP incorporates the same security features as the traditional Simple Network Management Protocol, SNMP. It also allows for the integration of other traditional security mechanisms, including RSA security mechanisms.

One embodiment of the present invention utilizes TMP and distributed on-line service information bases (DOLSIBs) to perform object routing. Alternatively, TMP can incorporate s-HTTP, Java™, the WinSock API or ORB with DOLSIBs to perform object routing. DOLSIBs are virtual information stores optimized for networking. All information entries and attributes in a DOLSIB virtual information store are associated with a networked object identity. The networked object identity identifies the information entries and attributes in the DOLSIB as individual networked objects, and each networked object is assigned an Internet address. The Internet address is assigned based on the IP address of the node at which the networked object resides.

For example, in FIG. 5A, Web server 104 is a node on the Internet, with an IP address. All networked object associated with Web server 104 will therefore be assigned an Internet address based on the Web server 104's IP address. These networked objects thus "branch" from the node, creating a hierarchical tree structure. The Internet address for each networked object in the tree essentially establishes the individual object as an "IP-reachable" or accessible node on the Internet. TMP utilizes this Internet address to uniquely identify and access the object from the DOLSIB. FIG. 6B illustrates an example of this hierarchical addressing tree structure.

Each object in the DOLSIB has a name, a syntax and an encoding. The name is an administratively assigned object ID specifying an object type. The object type together with the object instance serves to uniquely identify a specific instantiation of the object. For example, if object 610 is information about models of cars, then one instance of that object would provide user 100 with information about a specific model of the car while another instance would provide information about a different model of the car. The syntax of an object type defines the abstract data structure corresponding to that object type. Encoding of objects defines how the object is represented by the object type syntax while being transmitted over the network.

C. Management and Administration

As described above, exchange 501 and management agent 601 together constitute a VAN switch. FIG. 7 illustrates conceptually the layered architecture of VAN switch 520. Specifically, boundary service 701 provides the interfaces between VAN switch 520, the Internet and the Web, and multi-media end user devices such as PCs, televisions or telephones. Boundary service 701 also provides the interface to the on-line service provider. A user can connect to a local application, namely one accessible via a local VAN switch, or be routed or "switched" to an application accessible via a remote VAN switch.

Switching service 702 is an OSI application layer switch. Switching service 702 thus represents the core of the VAN switch. It performs a number of tasks including the routing of user connections to remote VAN switches, described in the paragraph above, multiplexing and prioritization of requests, and flow control. Switching service 702 also facilitates open systems' connectivity with both the Internet (a public switched network) and private networks including back office networks, such as banking networks. Interconnected application layer switches form the application network backbone. These switches are one significant aspect of the present invention.

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Management service 703 contains tools such as Information Management Services (IMS) and application Network Management Services (NMS). These tools are used by the end users to manage network resources, including VAN switches. Management service 703 also provides applica- 5 tions that perform Operations, Administration, Maintenance & Provisioning (OAM&P) functions. These OAM&P functions include security management, fault management, configuration management, performance management and billing management. Providing OAM&P functions for appli- 10 cations in this manner is another significant aspect of the present invention.

Finally, application service 704 contains application programs that deliver customer services. Application service 704 includes POSvc applications such as Bank POSvc described above, and illustrated in FIG. 6A. Other examples of VAN services include multi-media messaging, archival/retrieval management, directory services, data staging, conferencing, financial services, home banking, risk management and a variety of other vertical services. Each VAN service is 20 designed to meet a particular set of requirements related to performance, reliability, maintenance and ability to handle expected traffic volume. Depending on the type of service, the characteristics of the network elements will differ. VAN service 704 provides a number of functions including commu- 25 nications services for both management and end users of the network and control for the user over the user's environment.

FIG. 8 is a flow diagram illustrating one embodiment of the present invention. A user connects to a Web server running an exchange component in step 802. In step 804, the user issues a request for a transactional application, and the web server hands off the request to an exchange in step 806. The exchange activates a graphical user interface to present user with a list of POSvc application options in step 808. In step 810, the user makes a selection from the POSvc application list. In step 812, the switching component in the exchange switches the user to the selected POSvc application, and in step 814, the object routing component executes the user's request. Data is retrieved from the appropriate data repository via TMP in step 816, and finally, the user may optionally 35 continue the transaction in step 818 or end the transaction.

Thus, a configurable value-added network switching and object routing method and apparatus is disclosed. These specific arrangements and methods described herein are merely illustrative of the principles of the present invention. Numer- 40 ous modifications in form and detail may be made by those of ordinary skill in the art without departing from the scope of the present invention. Although this invention has been shown in relation to a particular preferred embodiment, it should not be considered so limited. Rather, the present invention is limited only by the scope of the appended claims.

The invention claimed is:

1. A computer-implemented method for delivering Point-of-Service applications to a multi-media device over the World Wide Web, said method comprising:

- providing a Web server in communication with a Web merchant's on-line Web application and a database;
- communicating a Web page for display on a multi-media device, where the Web page comprises a graphical user interface configured to generate a list of multiple Point-of-Service applications which may be accessed by the user over the Web and to accept user input;
- allowing the user to select an on-line Point-of-Service application displayed on the Web page on the multi-media device;
- instructing a Web server to hand over a request by the user to access the Web merchant's on-line service Web appli-

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cation available through the Point-of-Service application, said Web merchant's on-line service Web application available over the Web and in communication with the Web merchant's database;

maintaining an open connection over the Web until the user's transaction with the on-line Web application is complete;

delivering said particular Point-of-Service application in real-time to the multi-media device across a service network over the Web; and

performing a real-time non-deferred bidirectional Web transaction requested by the user.

2. The computer-implemented method of claim 1, wherein said request is handed over to an exchange from the Web application.

3. The computer-implemented method of claim 1, wherein the Point of Service application connects to the on-line service in real-time to provide inter-merchant services or intra-merchant services over the Web.

4. The computer-implemented method of claim 1, wherein said Point-of-Service application allows a user to buy or sell over the Web.

5. The computer-implemented method of claim 1, wherein said Point-of-Service application is a banking application that operates to connect to a financial institution over the Web.

6. The computer-implemented method of claim 1, wherein said Point-of-Service application is available for playing or billing over the Web.

7. A system for delivering Point-of-Service applications to a multi-media device over the World Wide Web, said system comprising:

a server comprising memory and a processor which comprise program instructions executable by the processor to implement Web application transactions over the application layer of the OSI model;

a Web server programmed to deliver a Web page displaying multiple Point-of-Service applications on a multi-media device for access by a user, where the Point-of-Service applications may be selected by the user to provide access to a Web Merchant's on line services, and providing for two-way communication between a Web Merchant's on-line Web application and the user;

instructions for the Web server to hand over the user's request to access a Point-of-Service application and to mediate the interactions between the user and the interface of the Web Merchant's on line service during at least one real-time transaction being through a graphical user interface displayed on the Web page on the user's multi-media device;

component connecting the Point of Service application on the web page to the on-line Web merchant's service over the Web with instructions for allowing the user to bi-directionally retrieve data stored on Web merchant's database and for writing data to the database in real-time, so that user and Web merchant can perform a non-deferred transaction.

8. The system for delivering Point-of-Service applications to a multi-media device over the World Wide Web of claim 7, wherein said request is handed over to an exchange component from a Web application.

9. The system for delivering Point-of-Service applications to a multi-media device over the World Wide Web of claim 7, wherein the Point of Service application connects to the on line service to provide inter-merchant services or intra-merchant services over the Web.

10. The system for delivering Point-of-Service applications to a multi-media device over the World Wide Web of

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claim 7, wherein said Point-of-Service application allows a user to complete a purchasing transaction in real-time over the Web.

11. The system for delivering Point-of-Service applications to a multi-media device over the World Wide Web of claim 7, wherein said Point-of-Service application is a banking application that operates to connect to a financial institution over the Web.

12. A Web application on line service network portal offered by a Web merchant, delivering Web applications to a multi-media device, said portal comprising a non-transitory computer storage device having stored thereon executable instructions that, when executed by one or more processors of a computer system, implement a method for:

delivering a Point-of-Service application interface on a Web page by the Web merchant to expose to an online services offered by the Web merchant as a Web application, said Web application including at least one object comprising information entries and attributes, wherein the object exposes one or more objects of a line of Web applications to the user;

providing said Point-of-Service application interface to allow a user to access the Web application from the Web

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application on-line service network portal offered by the Web merchant, delivering Web applications to the multi-media device;

connecting to the Web application on-line service, allowing the Web application on-line service client user access to the Web application on-line service; and maintaining the connection open until the Web application on-line service client user's real-time Web transaction with the Web application on-line service is complete so that the user may perform a real-time, non-deferred, bidirectional transaction on the Web.

13. The switching component of the web application service network portal offered by the Web merchant, delivering Web applications to a multi-media device of claim 12, wherein said switching component comprises a routing switch within the application layer of the OSI model to perform application layer routing.

14. The web application service network portal of claim 12, wherein said instructions include a handoff message from the Web server when the Web service client user requests said particular Web application to be accessed.

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